Technical Description

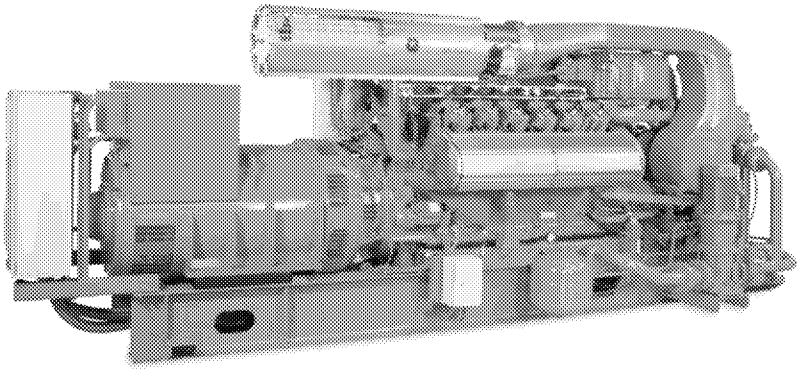
Genset

JGS 412 GS-S.L

with Island Operation

American Samoa
JGS 412 B91, 480V

Standard rating of the engines is for an installation at an altitude 0 ft (0 m) and an air intake temperature T1 < 95F (35 C). At T1 > 95F (35 C), a deration of 0.67%/F (1.2%/C) will occur to a temperature of 104 F (40 C). At T1 > 104F (40C), a deration of 1.11%/F (2.0%/C) will occur.



Electrical output 853 kWe

Emission values

NOx < 1.0 g/bhp-hr (NO2)

0.01 Technical Data (at genset)

Data at:				Full load	Part Load	
Fuel gas LHV		BTU/scft		1140		
				100%	75%	50%
Energy input		MBTU/hr	[2]	7,077	5,487	3,897
Gas volume		scfhr	*)	6,208	4,813	3,418
Mechanical output		bhp	[1]	1,180	885	590
Electrical output		kW el.	[4]	853	638	422
Heat to be dissipated			[5]			
~ Intercooler 1st stage (Engine jacket water cooling circuit)		MBTU/hr	[9]	564	249	33
~ Intercooler 2nd stage (Low Temperature circuit)		MBTU/hr		180	137	98
~ Lube oil (Engine jacket water cooling circuit)		MBTU/hr		478	420	345
~ Jacket water		MBTU/hr		846	764	624
~ Surface heat	ca.	MBTU/hr	[7]	198	~	~
Spec. fuel consumption of engine electric		BTU/kWel.hr	[2]	8,299	8,605	9,243
Spec. fuel consumption of engine		BTU/bhp.hr	[2]	5,997	6,199	6,604
Lube oil consumption	ca.	gal/hr	[3]	0.05	~	~
Electrical efficiency		%		41.1%	39.7%	36.9%

*) approximate value for pipework dimensioning
[_] Explanations: see 0.10 - Technical parameters

All heat data is based on standard conditions according to attachment 0.10. Deviations from the standard conditions can result in a change of values within the heat balance, and must be taken into consideration in the layout of the cooling circuit/equipment (intercooler; emergency cooling; ...). In the specifications in addition to the general tolerance of ±8 % on the thermal output a further reserve of +5 % is recommended for the dimensioning of the cooling requirements.

Main dimensions and weights (at genset)

Length	in	~ 220
Width	in	~ 80
Height	in	~ 90
Weight empty	lbs	~ 23,510
Weight filled	lbs	~ 24,830

Connections

Jacket water inlet and outlet	in/lbs	3"/145
Exhaust gas outlet	in/lbs	12"/145
Fuel Gas (at genset)	in/lbs	5"/232
Water drain ISO 228	G	½"
Condensate drain	in	0.7
Safety valve - jacket water ISO 228	in/lbs	2x1½"/2.5
Lube oil replenishing (pipe)	in	1.1
Lube oil drain (pipe)	in	1.1
Jacket water - filling (flex pipe)	in	0.5
Intercooler water-Inlet/Outlet 1st stage	in/lbs	3"/145
Intercooler water-Inlet/Outlet 2nd stage	in/lbs	2½"/145

Output / fuel consumption

ISO standard fuel stop power ICFN	bhp	1,180
Mean effe. press. at stand. power and nom. speed	psi	232
Fuel gas type		Flare gas
Based on methane number | Min. methane number	MN d)	60 | 60
Compression ratio	Epsilon	11.8
Min./Max. fuel gas pressure at inlet to gas train	psi	1.74 - 2.9 c)
Allowed Fluctuation of fuel gas pressure	%	± 10
Max. rate of gas pressure fluctuation	psi/sec	0.145
Maximum Intercooler 2nd stage inlet water temperature	°F	104
Spec. fuel consumption of engine	BTU/bhp.hr	5,997
Specific lube oil consumption	g/bhp.hr	0.15
Max. Oil temperature	°F	189
Jacket-water temperature max.	°F	203
Filling capacity lube oil (refill)	gal	~ 83

c) Lower gas pressures upon inquiry
d) based on methane number calculation software AVL 3.2 (calculated without N2 and CO2)

0.02 Technical data of engine

Manufacturer		GE Jenbacher
Engine type		J 412 GS-B91
Working principle		4-Stroke
Configuration		V 70°
No. of cylinders		12
Bore	in	5.71
Stroke	in	7.28
Piston displacement	cu.in	2,237
Nominal speed	rpm	1,800
Mean piston speed	in/s	437
Length	in	126
Width	in	59
Height	in	82
Weight dry	lbs	11,464
Weight filled	lbs	12,555
Moment of inertia	lbs-ft²	223.57
Direction of rotation (from flywheel view)		left
Radio interference level to VDE 0875		N
Starter motor output	kW	7
Starter motor voltage	V	24

Thermal energy balance

Energy input	MBTU/hr	7,077
Intercooler	MBTU/hr	744
Lube oil	MBTU/hr	478
Jacket water	MBTU/hr	846
Exhaust gas cooled to 356 °F	MBTU/hr	1,262
Exhaust gas cooled to 212 °F	MBTU/hr	1,641
Surface heat	MBTU/hr	75

Exhaust gas data

Exhaust gas temperature at full load	°F [8]	819 / 865 / 914
Exhaust gas mass flow rate, wet	lbs/hr	10,199
Exhaust gas mass flow rate, dry	lbs/hr	9,533
Exhaust gas volume, wet	scfhr	129,035
Exhaust gas volume, dry	scfhr	115,757
Max.admissible exhaust back pressure after engine	psi	0.870

Combustion air data

Combustion air mass flow rate	lbs/hr	9,875
Combustion air volume	SCFM	2,040
Max. admissible pressure drop at air-intake filter	psi	0.145

Sound pressure level

Aggregate a)		dB(A) re 20µPa	99
31,5	Hz	dB	90
63	Hz	dB	91
125	Hz	dB	98
250	Hz	dB	98
500	Hz	dB	97
1000	Hz	dB	93
2000	Hz	dB	89
4000	Hz	dB	87
8000	Hz	dB	89
Exhaust gas b)		dB(A) re 20µPa	117
31,5	Hz	dB	105
63	Hz	dB	120
125	Hz	dB	115
250	Hz	dB	113
500	Hz	dB	113
1000	Hz	dB	111
2000	Hz	dB	108
4000	Hz	dB	109
8000	Hz	dB	107

Sound power level

Aggregate	dB(A) re 1pW	119
Measurement surface	ft²	1,087
Exhaust gas	dB(A) re 1pW	125
Measurement surface	ft²	67.60

a) average sound pressure level on measurement surface in a distance of 3.28ft (converted to free field) according to DIN 45635, precision class 3.
b) average sound pressure level on measurement surface in a distance of 3.28ft according to DIN 45635, precision class 2.
The spectra are valid for aggregates up to bmep=232.060384 psi. (for higher bmep add safety margin of 1dB to all values per increase of 15 PSI pressure).
Engine tolerance ± 3 dB

0.03 Technical data of generator

Manufacturer		STAMFORD e)
Type		PE 734 B e)
Type rating	kVA	1,347
Driving power	bhp	1,180
Ratings at p.f.= 1.0	kW	853
Ratings at p.f. = 0.8	kW	844
Rated output at p.f. = 0.8	kVA	1,055
Rated reactive power at p.f. = 0.8	kVAr	633
Rated current at p.f. = 0.8	A	1,269
Frequency	Hz	60
Voltage	V	480
Speed	rpm	1,800
Permissible overspeed	rpm	2,250
Power factor (lagging - leading)		0,8 - 1,0
Efficiency at p.f.= 1.0	%	96.9%
Efficiency at p.f. = 0.8	%	95.9%
Moment of inertia	lbs-ft²	753.55
Mass	lbs	5,975
Radio interference level to EN 55011 Class A (EN 61000-6-4)		N
Ik" Initial symmetrical short-circuit current	kA	17.84
Is Peak current	kA	45.42
Insulation class		H
Temperature rise (at driving power)		F
Maximum ambient temperature	°F	104

Reactance and time constants (saturated)

xd direct axis synchronous reactance	p.u.	1.50
xd' direct axis transient reactance	p.u.	0.09
xd" direct axis sub transient reactance	p.u.	0.07
x2 negative sequence reactance	p.u.	0.09
Td" sub transient reactance time constant	ms	10
Ta Time constant direct-current	ms	20
Tdo' open circuit field time constant	s	2.14

e) GE Jenbacher reserves the right to change the generator supplier and the generator type. The contractual data of the generator may thereby change slightly. The contractual produced electrical power will not change.

connection variant 1K

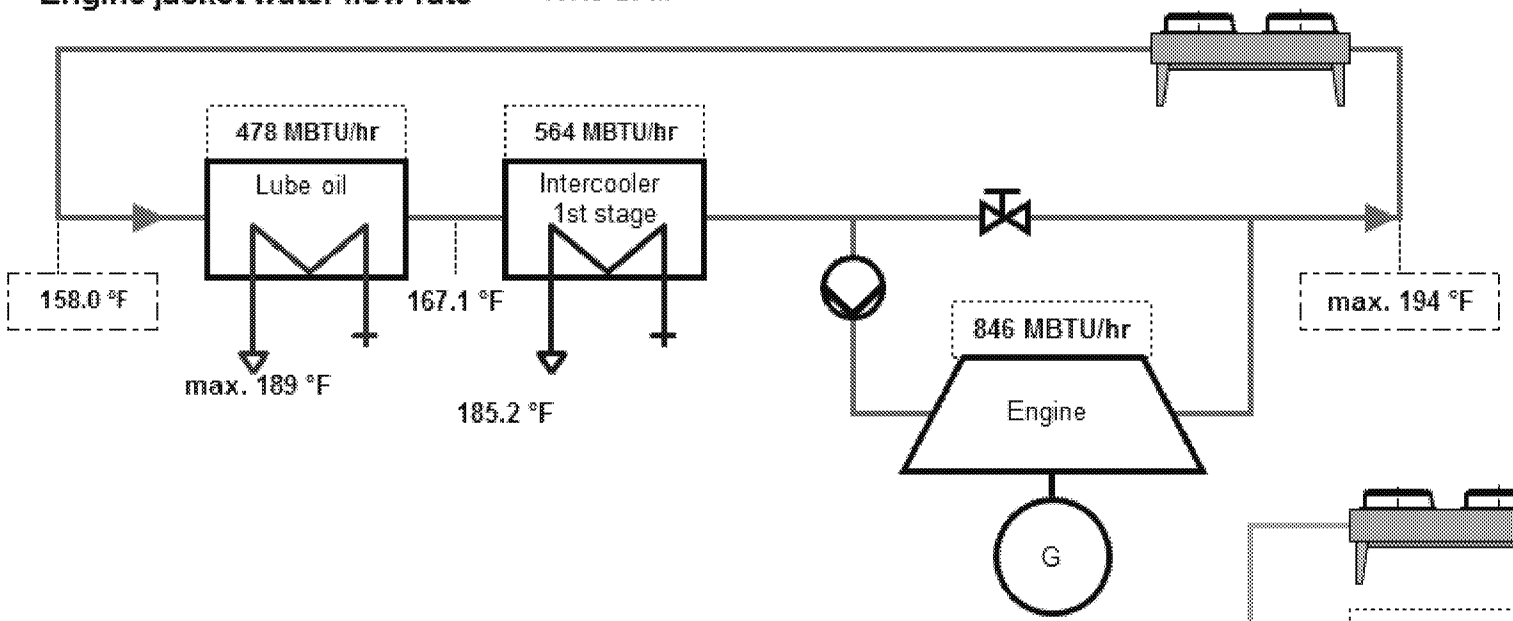
American Samoa J 412 GS-B91

Engine jacket water cooling circuit (calculated with Glykol 37%)

Heat to be dissipated = 1,888 MBTU/hr

(±8 % tolerance +5 % reserve for cooling requirements)

Engine jacket water flow rate = 117.6 GPM

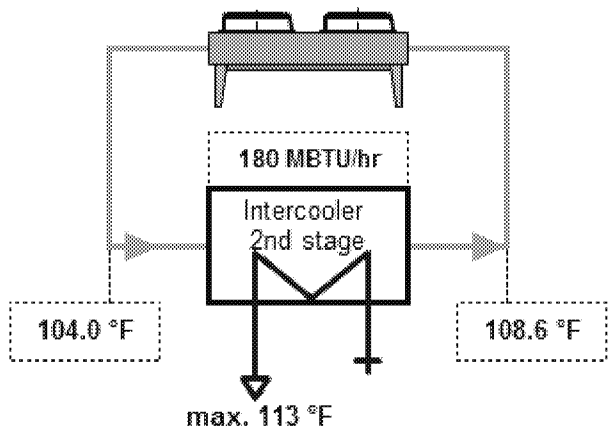


Low Temperature circuit (calculated with Glykol 37%)

Heat to be dissipated = 180 MBTU/hr

(±8 % tolerance +5 % reserve for cooling requirements)

Cooling water flow rate = 88.1 GPM



0.05 Cooling water circuit

Oil - heat (Engine jacket water cooling circuit)

Nominal output	MBTU/hr	478
Max. Oil temperature	°F	189
Loss of nominal pressure of engine jacket water	psi	7.25
Safety valve - max press. set point	psi	36.26

Engine jacket water - heat (Engine jacket water cooling circuit)

Nominal output	MBTU/hr	846
Max. engine jacket water temperature (outlet engine)	°F	194
Engine jacket water flow rate	GPM	117.6
Safety valve - max press. set point	psi	36.26

Mixture Intercooler (1st stage) (Engine jacket water cooling circuit)

Nominal output	MBTU/hr	564
Max. inlet cooling water temp. (intercooler)	°F	167.1
Design pressure of cooling water / (max. operating pressure)	lbs	145
Loss of nominal pressure of engine jacket water	psi	4.35
Safety valve - max press. set point	psi	36.26

Mixture Intercooler (2nd stage) (Low Temperature circuit)

Nominal output	MBTU/hr	180
Max. inlet cooling water temp. (intercooler)	°F	104
Aftercooler water flow rate	GPM	88.1
Design pressure of cooling water / (max. operating pressure)	lbs	145
Intercooler water pressure drop	psi	11.60
Safety valve - max press. set point	psi	36.26

The final pressure drop will be given after final order clarification and must be taken from the P&ID order documentation.

0.10 Technical parameters

The following "Technical Instruction (TI) of GE JENBACHER" form an integral part of the contract and must be strictly observed:

TI 1100-0110 – Boundary Conditions for GE Jenbacher Gas Engines
TI 1100-0111 – General Conditions – Operation and Maintenance
TI 1100-0112 – Installation of GE Jenbacher Units

These Technical Instructions reference other guides and instructions which can be provided upon request. These should be reviewed carefully by all personnel involved with the application, installation, and maintenance of any GE Jenbacher gas engine.

All data in the technical specification are based on engine full load (unless stated otherwise) at specified temperatures as well as the methane number and subject to technical development and modifications. For isolated operation an output reduction may apply according to the block load diagram. Before being able to provide exact output numbers, a detailed site load profile needs to be provided (motor starting curves, etc.).

All pressure indications are to be measured and read with pressure gauges (gauge).

(1) At nominal speed and standard reference conditions ICFN according to DIN-ISO 3046 and DIN 6271, respectively
(2) According to DIN-ISO 3046 and DIN 6271, respectively, with a tolerance of + 5 %.
Efficiency performance is based on a new unit (immediately upon commissioning).Effects of degradation during normal operation can be mitigated through regular service and maintenance work.
(3) Average value between oil change intervals according to maintenance schedule, without oil change amount
(4) At p. f. = 1.0 according to VDE 0530 REM / IEC 34.1 with relative tolerances
(5) Total output with a tolerance of +/- 8 %
(6) According to above parameters (1) through (5)
(7) Only valid for engine and generator; module and peripheral equipment not considered (at p. f. = 0.8)
(8) Exhaust temperature with a tolerance of +/- 8 %
(9) Intercooler heat on:
*** standard conditions (Vxx)** - If the turbocharger design is done for air intake temperature > 86°F w/o de-rating, the intercooler heat of the 1st stage need to be increased by 2%/K starting from 77°F. Deviations between 77 – 86°F will be covered with the standard tolerance.
*** Hot Country application (Vxxx)** - If the turbocharger design is done for air intake temperature > 104°F w/o de-rating, the intercooler heat of the 1st stage need to be increased by 2%/K starting from 95°F. Deviations between 95 – 104°F will be covered with the standard tolerance.

Definition of output

- ISO-ICFN continuous rated power:
  Net break power that the engine manufacturer declares an engine is capable of delivering continuously, at stated speed, between the normal maintenance intervals and overhauls as required by the manufacturer. Power determined under the operating conditions of the manufacturer's test bench and adjusted to the standard reference conditions.

- Standard reference conditions:

Barometric pressure:	1000 mbar or 100 m above sea level
Air temperature:	25°C or 298 K
Relative humidity:	30 %

- Volume values at standard conditions (fuel gas, combustion air, exhaust gas)

Pressure:	1013.25 mbar
Temperature:	0°C

Output adjustment for turbo charged engines

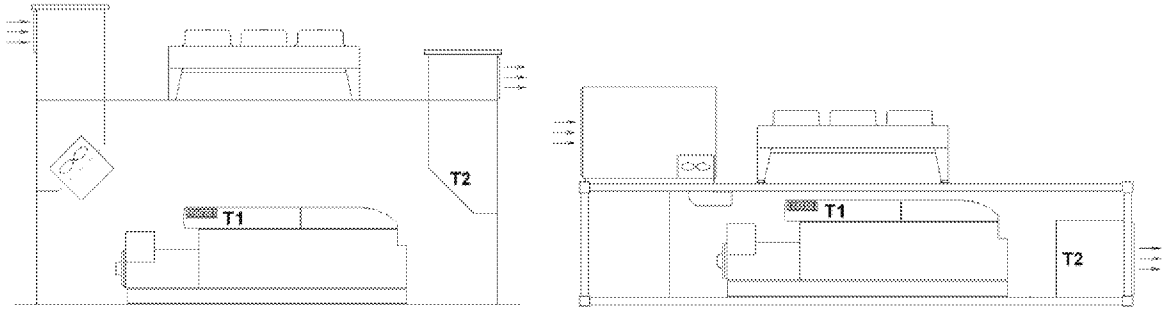
Standard rating of the engines is for an installation at an altitude 0 ft (0 m) and an air intake temperature T1 < 95F (35 C). At T1 > 95 F (35 C), a deration of 0.67%/F (1.2%/C) will occur to a temperature of 104 F (40C). At T1 > 104F (40C), a deration of 1.11%/F (2%/C) will occur.

Radio interference level

The ignition system of the gas engines complies the radio interference levels of CISPR 12 and EN 55011 class B, (30-75 MHz, 75-400 MHz, 400-1000 MHz) and (30-230 MHz, 230-1000 MHz), respectively.

Parameters for the operation of GE Jenbacher gas engines

Maximum room temperature: 122°**F** (T2) -> engine stop



If the actual methane number is lower than the specified, the knock control responds. First the ignition timing is changed at full rated power. Secondly the rated power is reduced. These functions are carried out by the engine management.

Operation of Voltage and frequency outside of stated limits for the generator as per IEC 60034-1 Zone A will result in a power de-rate up to and including tripping of the equipment.

The generator set fulfills the limits for mechanical vibrations according to ISO 8528-9.
If possible, railway trucks must not be used for transport (**TI 1000-0046**).

Parameters for the operation of control unit and the electrical equipment

Relative humidity: 50%
Maximum temperature: 40°C.
Altitude: <2000m above the sea level.
The gas quantity indicated under the technical data refers to standard conditions with the given calorific value. The actual volume flow (under operating conditions) has to be considered for dimensioning the gas compressor and each gas feeding component – it will be affected by:

- Actual gas temperature (limiting temperature according to **TI 1000-0300**)
- Gas humidity (limiting value according to **TI 1000-0300**)
- Gas Pressure
- Flare Gas constituents are as follows:
  C1 = 83%; C2 = 4%; C3 = 9%